REMARKS

Claims 1-36, 46-49, 51-53, 55-57, 59-61, 63, 65, and 67 are pending in the application. Claims 1-36, 46-49, 51-53, 55-57, 59-61, 63, 65, and 67 are rejected.

In the Final Office Action of June 30, 2005, the Examiner again rejected claims 1-36, 46-49, 51-53, 55-57, 59-61, 63, 65 and 67 pursuant to 35 U.S.C. §103(a) as being unpatentable over the combined teachings of Wright et al. (U.S. Patent No. 5,685,308) and Cole et al. (U.S. Patent No. 5,617,862), further in view of Doi et al., Muzilla, Deitrich et al., Snyder or Morrow or further in view of (a) Scheib et al. (U.S. Patent No. 5,628,321) or Pflugrath et al. (U.S. Patent No. 5,603,323) or (b) Hall (U.S. Patent No. 5,394,520) or Zellenga et al. (U.S. Patent No. 5,144,242).

In the Advisory Action of November 16, 2005, the Examiner merely noted that "the reprogrammable logic of the secondary references is essential to the functionality of the subsystems in which they reside."

Claims 1, 11, 21, 31, 34, 51, and 55 have been amended.

Applicants respectfully request reconsideration of the rejections.

Independent claims 1 and 11 recite that the essential data processing functionality of the subsystem includes data processing of ultrasound data and that the essential data processing functionality of the subsystem largely resides in at least one but less than three reprogrammable logic device components.

Wright et al. disclose a flexible beamformer system (col. 4, lines 38-41). However, Wright et al. do not disclose reprogrammable logic device components for implementing the programmable beamformer system.

Cole et al. disclose using a field programmable gate array for implementing a multiplexer scheme (col. 12, lines 48-52). However, the field programmable gate arrays of Cole et al. are not used for data processing, only data routing.[1]

In the Advisory Action, the Examiner relied on the secondary references (Dietrich, Snyder, McMarrow, Doi et al., Muzilla et al., Scheib et al., Pflugrath et al., Hall and Zellenga et

[1] See the previously submitted declarations of John Williams regarding use of FPGA's in Acuson's Sequoia ultrasound system. The Wright et al. and Cole et al. patents also disclose aspects of the Sequoia ultrasound system.

al.) as showing that reprogrammable logic is essential to the function of the subsystems. However, the specification defines essential functionality along the lines of basic verses peripheral function. "As used herein, the essential functionality comprises the function to be performed by the subsystem, such as generating a transmit waveform for a transmit beamformer subsystem or scan converting data from an acoustic grid to a display format for a scan converter. In one embodiment, the essential functionality largely (i.e. at least 40% of the processing or signal path) resides in one or more re-programmable logic devices." (page 14, lines 7-12). These secondary references do not show data processing of ultrasound data as an essential data processing functionality largely residing in at least one but less than three reprogrammable logic devices.

The secondary references Dietrich, Snyder and McMarrow use re-programmable logic devices for control functions, not ultrasound data processing functions. Dietrich et al. use an FPGA for controlling interpolation by other components (col. 4, lines 56-60 and col. 5, lines 42-49). Dietrich et al. do not suggest using FPGA devices for the essential data processing functionality of a subsystem.

Likewise, Snyder discloses using a FPGA as a logic controller (col. 5, lines 26-39). The logic controller maps the switching function of a multiplexer (col. 5, lines 50-53 and 61-65). Snyder does not disclose using FPGA devices for the essential data processing functionality of a subsystem.

Similarly, McMarrow et al. disclose using an FPGA for multiplexing (col. 5, line 66-col. 6, line 1). McMarrow et al. do not suggest using FPGA devices for the essential data processing functionality of a subsystem.

The secondary reference Doi et al. does not indicate how the re-programmable logic devices are used. Doi et al. disclose an FPGA as one possible component of many components on a motherboard (col. 5, lines 40-46). The Examiner lists various devices as stated equivalents, but Doi et al. do not discuss all the listed possible devices as equivalents. Further, Doi et al. do not disclose how any FPGA is used.

The secondary reference Muzilla et al. discloses converting flow estimates to 8 bit and 4-bit outputs and applying thresholding with a output logic block (col. 6, lines 17-25). The output logic block includes a field programmable gate array which selects parameters to be displayed (col. 11, lines 13-19). The output logic block also performs median filtering of M-mode data

(col. 11, lines 25-27). The output logic block is a small part of the color processing flow system (col. 4, lines 21-22; Figure 3). Muzilla et al. use an re-programmable logic device for merely selecting data that is converted, thresholded, and filtered in an output logic block of a color processing flow system. There is no indication of a large amount of data processing by the re-programmable logic device in Muzilla et al. Largely is defined in the specification as 40% of processing or the signal path. The reprogrammable logic device selecting data in Muzilla et al. is not the reprogrammable logic device performing data processing of ultrasound data.

With further reference to Muzilla et al., selection of parameters for display is also not an essential data processing functionality of a subsystem. Muzilla et al. provide a color processing flow system. The typical essential data processing functionalities of color processing flow subsystems are detecting or estimating flow (e.g., velocity, power or variance) and assigning color values. Applicants are not claiming functions essential to the operation of the subsystem, but is claiming the essential data processing functionality including data processing of ultrasound data. Given a clear definition by the Applicants, the Examiner may not create another meaning. Accordingly, the interpretation of the reprogrammable logic devices of the secondary references being essential to the function of the subsystem is not correct. A single resistor may be essential (i.e., the subsystem may not function correctly without the resistor). Any use of a reprogrammable logic device in the secondary references may be essential to the function of the subsystem. Instead, Applicants are claiming an essential data processing functionality of the subsystem. A subsystem performs an "essential data processing" function. The names of many devices derive from this essential data processing function. A detector detects, a scan converter scan converts, and a beamformer beamforms. Muzilla et al. use the reprogrammable logic device for selecting parameters for display - something essential to displaying but not an essential functionality of the color processor flow subsystem.

The Examiner characterized this interpretation of "essential functionality" as peripheral (Office Action dated June 30, 2005, page 3). Given "non-essential in the sense of peripheral," the Examiner alleged obviousness in view of Scheib et al. and Pflugraph et al. to use a "reprogrammable device such as an EEPROM." Secondary references Scheib et al. and Pflugraph et al. do not suggest using re-programmable logic devices for data processing in an ultrasound subsystem. Both references teach use of reprogrammable EEPROMs. The Examiner alleges that "at least EEPROM type re-programmable devices were known to extend core

functionalities in controlling scan operation and specialty calculations." However, EEPROMs are not re-programmable logic devices. EEPROMs are memory devices. Re-programmable logic devices are defined in the speciation as: "as used herein, a re-programmable logic device comprises a plurality of logic elements the gate interconnections of which can be modified by an external data set loaded under software control by a processor residing in the system. Such re-programmable logic devices include field programmable gate arrays (FPGA), flash PROM FPGA, static random access memory FPGA (SRAM FPGA) , anti-fuse programmable logic devices, complex-programmable logic devices (C-PLD), electrically erasable PLD devices and other re-programmable PLD devices." (page 13, line 27-page 14, line 2). EEPROMs store information, but do not provide reprogrammable logic devices. There is no suggestion to use reprogrammable logic devices instead of EEPROMs. Any suggestion to use EEPROMs on medical systems does not suggest extending functions for re-programmable logic devices. Scheib and Pflugrath et al. do not suggest the re-programmable logic devices performing essential data processing functionality including data processing ultrasound data.

Regarding secondary references Hall and Zellenga et al., the Examiner alleges that "at least EPLD use was extended to core functionalities of imaging systems in general and to medical imaging in particular" (Office Action dated June 30, 2005, page 4). However, a person of ordinary skill in the art would not have provided a subsystem's essential data processing functionality largely residing in re-programmable logic devices based on the disclosures of Hall and Zellenga et al. These examples do not show use of re-programmable logic devices as claimed even in non-ultrasound contexts. Hall uses re-programmable logic devices in two ways. First, re-programmable logic devices are used for control functions (col. 7, lines 2-6), not data processing. Second, re-programmable logic devices are used for a convolver subsystem that also has a correlator (col. 7, lines 11-18). The function of a convolver is basically correlation, so the correlator provides the essential data processing functionality. EPLDs are not used for an essential data processing functionality, but are instead peripheral. The function of the subsystem is not shown to largely reside in EPLDs.

Zellenga et al. use re-programmable logic devices for control, not data processing (col. 10, lines 15-23). A control sequencer is shown in the cited figures 7-11 and 13 (col. 9, lines 63-68; col. 14, lines 45-58; col. 18, lines 60-63; col. 19, lines 48-54; col. 23, lines 16-17 and 29-32; and col. 24, lines 16-17 and 42-44). The cited references do not use re-programmable logic

devices for essential data processing functions including data processing of ultrasound data with the essential data processing functionality largely residing in the reprogrammable logic device, so do not suggest progress of re-programmable logic devices into data processing of ultrasound data as claimed in claims 1 and 11.

Even if Hall's use of re-programmable logic devices in the convolver provides essential data processing function of a subsystem largely residing in an re-programmable logic device, a single example in a very different type of imaging would not have suggested a general progress of re-programmable logic devices into imaging. A person of ordinary skill in the art would not have used re-programmable logic devices in ultrasound imaging for essential data processing functionality.

Hall is for infrared imaging visible objects and Zellenga et al. is for MRI, not medical diagnostic ultrasound imaging. There is no motivation to use re-programmable logic devices in medical diagnostic ultrasound as claimed. The Examiner alleges two imaging examples show general progress into adopting re-programmable logic devices for core functions in imaging, thus resulting in use in ultrasound imaging. However, a mere two examples do not show general progress.

The dependent claims 2-10, 12-20, 48-49, 51-53 and 55 depend from independent claims 1 and 11 and are thus allowable for at least the same reasons as discussed above. Further distinctions over the prior art are not provided herein for brevity but will be provided if requested by the Examiner.

As discussed below, none of the references cited by the Examiner disclose a reprogrammable logic device in a beamformer as claimed in claims 6 and 7.

The Examiner continues to not respond to arguments for claims 21, 26, 31 and 34. The cited references fail to disclose the claimed use of the claimed number of reprogrammable logic devices. These claims do not rely on "essential data processing functionality." The Examiner has failed to suggest migration into these specific components with the specific numbers of devices.

Claims 21 requires a beamformer comprising at least one re-programmable logic device operable to generate transmit waveforms, delay ultrasound data or waveforms, apodize across

channels or to sum ultrasound data. Claim 26 requires beamforming data at least one reprogrammable logic device. None of the cited references disclose this limitation. As discussed above, Wright et al. do not disclose reprogrammable logic device components for implementing the programmable beamformer system. Cole et al., McMorrow, and Snyder use FPGAs for multiplexing, not as a beamformer. Hall uses re-programmable logic devices in a controller and a convolver. Zellenga et al. use re-programmable logic devices in a controller for a sequencer. The Examiner does not cite to a beamformer with at least one re-programmable logic device in any of the other listed references.

The dependent claims 22-25, 27-30, 56-57, 59-61 and 63 depend from independent claims 21 and 26, and are thus allowable for at least the same reasons. Further distinctions over the prior art are not provided herein for brevity but will be provided if requested by the Examiner.

Claims 31 and 34 require a scan converter comprising at least one but less than three re-programmable logic devices to convert ultrasound data from one format to another format. None of Wright et al., Cole et al., Doi et al., Muzilla, Deitrich et al., Snyder, McMorrow, Hall nor Zellenga et al. disclose a scan converter having one to three re-programmable logic devices. Wright et al. does not disclose reprogrammable logic device components for implementing a scan converter. Cole et al., McMorrow, and Snyder use FPGAs for multiplexing, not as a scan converter. Doi et al. disclose an ultrasound system that may have an FPGA and/or other devices, not a scan converter with a re-programmable logic device. Muzilla discloses an FPGA for selecting data, but does not suggest a scan converter having a re-programmable logic device. Zellenga et al. and Deitrich et al. use an FPGA or EPLD for control, not scan conversion. Hall use re-programmable logic devices for correlating frames of data together to predict displacement, not as a scan converter.

The dependent claims 32-33, 35-36, 65 and 67 depend from independent claims 31 and 34, and are thus allowable for at least the same reasons. Further distinctions over the prior art are not provided herein for brevity but will be provided if requested by the Examiner.

CONCLUSION

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application in the next Office Action and believes that an interview would be helpful to resolve any remaining issues, he is respectfully requested to contact the undersigned attorney at (650) 943-7350 or Craig Summerfield at (312) 321-4726.

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